Student's Name:

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DEPARTMENT OF COMPUTER ENGINEERING
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CENG 383 Real-Time Systems

MIDTERM EXAM (29.04.2014)

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1. Let us express real-time tasks with tuple $< E_i, T_i, D_i, P_i >$ where E_i is the execution time, T_i is the period, D_i is the deadline and P_i is the priority. Assume that the application consists of 4 periodic independent tasks given with the following tuples:

$$\tau_1 :< 1, 4, 4, 4 >, \tau_2 :< 2, 8, 8, 3 >, \tau_3 :< 2, 16, 16, 2 >, \tau_4 :< 6, 64, 64, 1 > .$$

(a) (15 pts) Make a schedulability analysis according to the Rate-Monotonic algorithm.

(b) (10 pts) Calculate the hyperperiod.

2. The following is an excerpt from the informal specification of a system: *"....The opening and closing of the door take 5 seconds each due to the slow hydraulic system, and re-opening the door when it is not fully closed is hazardous and prohibited. The reverse operation however, that is, re-closing the door while it is opening is allowed. There is no sensor telling about the door position, so after pressing the close button, the only way to make sure that the door is fully closed is to wait for minimum 5 seconds ..."*

(a) (15 pts) Please draw a timed automaton that models the door.

(b) (10 pts) Please draw a timed automaton modeling the behavior of the user such that the user may press the open and close buttons whenever (s)he wishes.

(c) (10pts) Please write a safety property formally specifying the door operation that is hazardous and prohibited.

(HINT: recall that the communication between two automata can be done via synchronization channels.)

3. (25 pts) We want to run a periodic checkpointing in a single program. The execution time of the program is 6 hours. The execution time of one checkpoint is 20 minutes and the execution time of rollback can be neglected. We are expected to minimize the total execution time of the program against one failure that can happen during the execution at an arbitrary time. What would be the optimum checkpointing period? (HINT: For example, if we took just one checkpoint in the middle of the program, the worst case execution time would be 6 hours + 20 minutes + 3 hours)

4. (15 pts) Please distinguish between *fault*, *error* and *failure* in a short paragraph.
